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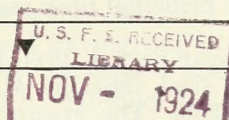
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PRODUCTION OF HENEQUEN FIBER IN YUCATAN AND CAMPECHE

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CONTENTS

	Page		Page
Introduction.....	1	Plantation organization and manage-	5
Outline of the binder-twine fiber sit-		ment.....	
uation.....	1	Henequen fiber.....	13
Importance of henequen in Yucatan.....	2	Present production.....	17
Climatic conditions.....	2	Condition of plantations.....	17
Soil conditions.....	2	Market situation.....	18
Geographical distribution.....	3	Future production of fiber.....	18
Areas planted.....	3	Henequen in Campeche.....	19
Varieties.....	4	Summary.....	20

INTRODUCTION

Henequen¹ fiber has been imported in steadily increasing quantities into the United States during the past 40 years. The average annual imports of this fiber, which were 40,000 tons during the 5-year period 1887-1891, had increased to an annual average of 148,000 tons during the 4-year period 1918-1921.

The two features of the henequen situation of special interest to the American farmer are that this fiber constitutes the main source of supply of the raw material used for the manufacture of binder twine and that practically all the henequen imported into the United States is obtained from the States of Yucatan and Campeche. The condition of their henequen industry therefore has a very important bearing on the welfare of the grain-producing industry of the United States.

OUTLINE OF THE BINDER-TWINE FIBER SITUATION

The United States consumes annually from 100,000 to 150,000 tons of binder twine and exports from 30,000 to 50,000 tons.

This twine is manufactured from henequen, sisal, abaca (pronounced a-ba-ká; Manila hemp), maguey, istle, and phormium (New Zealand flax) fibers. Henequen fiber, with the exception of a very

¹ Henequen (pronounced *hen-e-kén*) is the gray-leaved plant, *Agave fourcroydes* Lem., cultivated in Yucatan and Campeche. Its fiber, usually known in the market as sisal, is different from the true sisal, which is produced by a distinctly different species of agave.

small quantity, is obtained from Yucatan and Campeche; the sisal principally from Java, East Africa, and the Bahama Islands; the abaca and maguey from the Philippine Islands; the istle from Mexico; and the phormium from New Zealand.

During recent years, because of unsettled conditions both on the plantations and in the world markets there has been considerable variation in the relative quantities of these different fibers used for binder-twine purposes. For a long period, however, Yucatan henequen has been the principal fiber used for the manufacture of binder twine.

During the 10-year period, 1911-1920, the average annual imports of henequen and sisal into the United States were 163,703 tons, valued at \$28,507,956. The greater part of this fiber was used for the manufacture of binder twine, and for many years more than 90 per cent of the combined total imports has been henequen.

From 1915 to 1921 the available supply of this fiber was irregular, there was great fluctuation in the price, and the market was very unsettled. Since January 1, 1922, the production, although much less than that of earlier years, has been fairly regular, and a stable price has been maintained.

Even with a gradual improvement of conditions in Yucatan, there is likely to be a shortage of henequen fiber for several years. Since there is no probability of any marked decrease in the world consumption of binder twine, any shortage in supply of henequen fiber must be met by an increased production of other fibers suitable for binder-twine purposes.

IMPORTANCE OF HENEQUEN IN YUCATAN²

The production of henequen is by far the leading industry of Yucatan. In value this fiber constitutes about 85 per cent of the total exports, the others of importance being chicle gum and hides.

Both soil and climatic conditions are peculiarly well adapted to the cultivation of henequen, whereas they are ill adapted to the cultivation of most of the other staple crops of the Tropics. Under these circumstances the maintenance of the henequen industry in a prosperous condition is a matter of vital importance to the people.

CLIMATIC CONDITIONS

The climate of Yucatan is tropical, the lowest recorded temperature being 48° F. The precipitation is relatively low, approximately 30 inches per annum, and there is a long dry season. These conditions are favorable for henequen, although occasionally during an exceptionally long dry season even this hardy plant suffers some injury. It would be difficult to find any other staple tropical crop so well adapted to the climatic conditions of the northern part of the State.

SOIL CONDITIONS

In the area utilized for the production of henequen the surface is relatively flat, slightly rolling, and somewhat broken. The soil is

²This report is based on field investigations made in Yucatan and Campeche during June and July, 1923, by H. T. Edwards, who wrote it immediately upon his return. Important changes have taken place since.

largely composed of a porous, partially decomposed limestone in which there are numerous pockets and in places a thin fertile covering. The land is so rocky that trees can not be planted until holes have been blasted for them to grow in, and frequently even the small henequen suckers are propped up with small stones in places where there is practically no soil. Under these conditions the profitable cultivation on a commercial scale of any other crop would be exceedingly difficult if not impossible. These unusual soil conditions, however, are practically ideal for henequen.

Although it will thrive on land having but little soil, there are kinds and degrees of "rockiness" favorable and unfavorable for this plant. For instance, the soil conditions in the vicinity of the town of Motul are regarded as exceptionally favorable, for the reason that in this section the soil is filled with medium-sized and small rocks rather than having the unbroken strata of rock found in certain other localities.

The soils found in the eastern and southern sections of the henequen areas of Yucatan and in Campeche are more fertile and less rocky than the soils of north-central Yucatan, which is the principal producing region. Most of the planters believe that the fertile soils are not favorable for henequen. One objection to its cultivation in such soils is the increased cost of keeping down the weeds and undergrowth which grow very quickly in this country even on rocky lands.

GEOGRAPHICAL DISTRIBUTION

Henequen is widely distributed throughout a large portion of the States of Yucatan and Campeche, but the principal fiber-producing area is a district which extends for about 60 miles south of Progreso and approximately the same distance east of Progreso and Merida. The town of Motul, about 30 miles northeast of Merida, is the center of one of the largest and most prosperous henequen-producing sections. The conditions in this district are specially favorable. Good yields are obtained, and the fiber is of excellent quality. Many of the lands lying between Merida and Progreso are planted to henequen, and there are a number of large plantations south of Merida. A large part of the lands lying on both sides of the railway between Merida and Temax is planted to henequen. To the north, between Temax and the sea, the henequen belt extends somewhat farther to the east. Along the seacoast east of Progreso and north of Merida, Motul, and Temax there is a belt of jungle land, roughly from 3 to 5 miles wide. Throughout this uncultivated area are many scattering plants of wild agaves, including henequen apparently introduced from the plantations, and other species that may be indigenous. Henequen is not known as an indigenous plant.

AREAS PLANTED

There is considerable variation in the figures furnished by different native authorities on the total area planted to henequen, the relative areas in large, medium, and small plantations, and the relative areas in old, medium, and young plantings.

The Comisión Exportadora de Yucatan, which handles all the fiber and is in closer touch with the industry in Yucatan and Cam-

peche than any other agency, estimates the total area planted to henequen in these States as 5,400,000 mecates,³ which is equivalent to 216,000 hectares or approximately 540,000 acres, of which 40 per cent is in large, 30 per cent in medium, and 30 per cent in small plantations. The large plantations range in size from 3,000 to 6,000 acres. The "San Francisco," in the Motul district, said to be the largest plantation in Yucatan, has approximately 6,500 acres planted to henequen.

Only an approximate estimate can be made of the relative areas in young, medium, or producing, and old plantings. Such an estimate in July, 1923, indicated that about 50 per cent of the total area, or 270,000 acres, was in the producing state; about 40 per cent, or 216,000 acres, in plantings 2 to 6 years old; about 8 per cent in plantings less than 2 years old; and about 2 per cent in old fields that had ceased to be profitable.

The total number of henequen plantations in Yucatan is variously reported to be anywhere from 200 to 850, according to what is considered a "plantation." There are probably between 500 and 800 properties which may properly be so regarded. One report shows a total of 550 plantations, of which 19 have an annual production in excess of 500,000 kilos (over 1,000,000 pounds) of fiber, 75 an annual production in excess of 100,000 kilos of fiber (more than 200,000 pounds), and the remaining 456 a smaller production. The total exportation of henequen fiber from Yucatan during 1923 was 612,745 bales, or approximately 248,000,000 pounds, of fiber.

More accurate statistics of acreage with respect to the age of the plants would be desirable as a basis for estimating the production during the next six years. The young plants do not yield fiber until six or seven years after they are set in the field, and the old plants yield reduced quantities, so that under normal conditions it is not profitable to harvest leaves from them.

VARIETIES

Eight different varieties of henequen are recognized, the local names of which are as follows: "Quintán-ci," "bab-ci," "cahún-ci,"⁴ "chelén-ci," "yax-ci,"⁴ "sac-ci," "chucún-ci," and "xix-ci." Comparatively little investigation of the different varieties of henequen has been made, and there is confusion and misunderstanding concerning them. The same variety may therefore be given various local names, or dissimilar varieties may bear the same name in different localities.

The three varieties most extensively cultivated are the sac-ci, the chucún-ci, and the quintán-ci. Many of the large plantations have plants of all these varieties.

The sac-ci variety is planted more extensively than all others combined. It is of medium size, the trunk when fully developed being from 4 to 5 feet in height. The leaves are bluish gray in color, from 4½ to 5 feet in length and from 3½ to 4 inches in width. Under favorable conditions this plant lives from 25 to 30 years

³ The mecate, which is approximately one-tenth of an acre, is the unit of surface measurement used in Yucatan.

⁴ The name cahún-ci is also used in Yucatan to designate *Furcraea cahum* and yax-ci to designate sisal, *Agave sisalana*, which are distinct from the true henequen.

and produces from 20 to 30 leaves per annum. The fiber obtained from this variety is relatively coarse, strong, and white, and the yield is large.

The chucún-ci variety, which is also widely planted, differs somewhat in appearance from the sac-cí (fig. 1). The leaves of the chucún-ci are broader and of a more pronounced greenish color and are also somewhat marked with small brownish spots. This variety matures more slowly than the other, but lives rather longer. The fiber is relatively short but coarse and heavy. The yield of fiber is said to be a little less than that of the sac-cí.

The quintán-ci, which closely resembles the chucún-ci, produces fiber of excellent quality, but the yield is somewhat less than that of the varieties previously mentioned.

PLANTATION ORGANIZATION AND MANAGEMENT.

During recent years there have been modifications in both the organization and the system of management of the henequen plantations, and changes are still occurring.

The industry was organized and developed by a relatively small number of planters. The early estates have passed from one generation to another, steadily increasing in size and yield. As the production of henequen has been very profitable, these large planters have had abundant capital with which to develop and improve their estates. Furthermore, they have had at their command an abundant supply of very cheap labor. In clearing the land, planting the fields, and caring for the crops, any marked degree of economy in the use

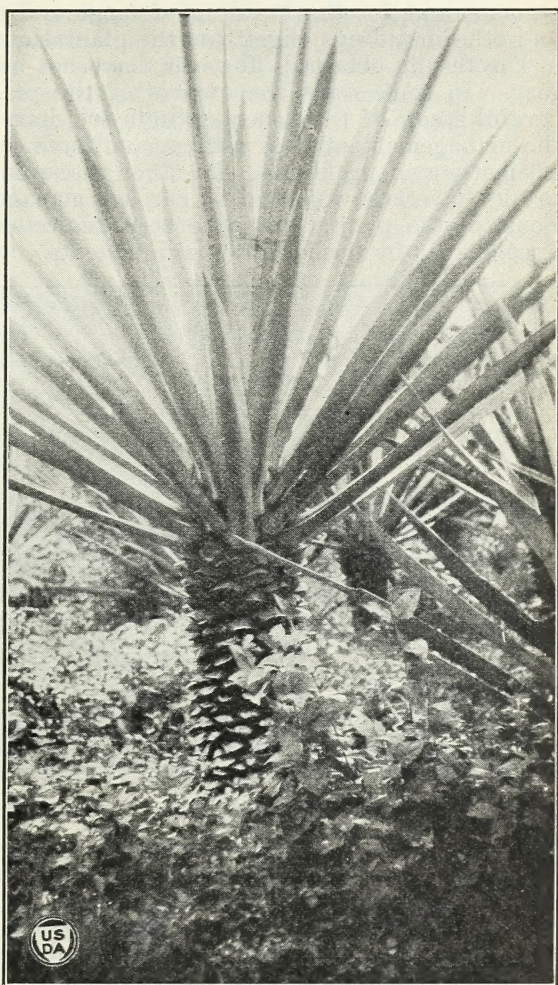


FIG. 1.—A well-developed henequen plant of the "chucún-ci" variety.

of labor has not been regarded as a matter of special importance. Under these favorable conditions it has been possible for the planters to operate on a large scale and to maintain well-equipped and efficient working organizations. The necessary capital has been available for the construction of railways throughout the plantations and to near-by towns, for the purchase and installation of expensive machinery, and for the building of large and commodious residences and other buildings (fig. 2) on the plantations.

The results obtained, however, have not been uniformly satisfactory. In some cases the owners of the plantations have made a careful study of the henequen industry, have personally supervised the management of their estates, and have conducted their business efficiently and profitably. In other cases, however, large and easy profits have been followed by careless management, waste, and loss. Some of the plantations have been neglected by their owners and mismanaged by inefficient superintendents.

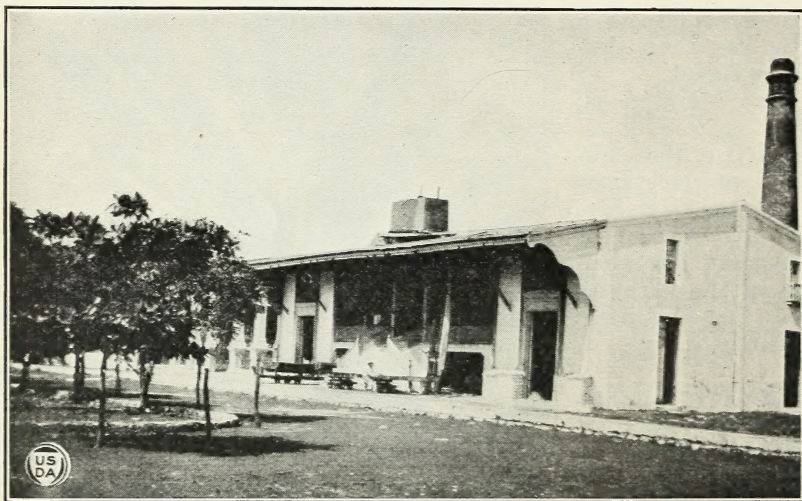


FIG. 2.—The mill and warehouse on a henequen plantation in Yucatan

Yucatan is now entering upon a period of reconstruction, and it is inevitable that there should be a certain amount of friction and difficulty in connection with the adjustment of the old to the new conditions. With the increasing competition of other countries in the production of fiber, with a large increase in the cost of all equipment used on the plantations, and with a labor situation entirely different from that of the early days of the industry, the henequen planter is no longer able to conduct his business as it was usually managed in former years.

The tendency at the present time in Yucatan is to increase the number and to reduce the size of the henequen plantations. With the difficult industrial and economic conditions that have existed in the State for several years, most of the old planters have found it impossible to cultivate as large areas as formerly. In some cases two or more plantations have been combined into one, many of the old fields have been either neglected or entirely abandoned, nursery planting has been largely discontinued, and various other changes

have been made. In some respects these changes will result in more economical production, but in other ways there will be a decrease in efficiency.

The economical production of henequen requires not only the purchase and operation of expensive machinery but also the cultivation of large areas of land to furnish a steady supply of leaves for the operation of the fiber-cleaning machines. Furthermore, this crop must be cultivated for six or seven years before it yields any return. For these reasons this is essentially a large-plantation industry. Although it is not impossible that some system of cooperative cleaning plants may be developed by groups of small planters, it is by no means certain that it would be a success in Yucatan.

Although it will be possible to make some reduction in the present size of the larger plantations and still to maintain the production of henequen on a satisfactory and economical basis, this movement may easily assume dangerous proportions. While it is very necessary that the plantation laborers be given such protection that they may be assured of reasonable working hours and a fair wage, it is also important that attention be given to the question of maintaining an adequate supply of plantation labor and of encouraging habits of industry and thrift on the part of the laborers.

As henequen is the one important crop and as the condition of this industry determines the degree of prosperity of practically the entire population of the country, it is exceedingly important that the Government officials, the planters, and the laborers cooperate in a wise and conservative policy that will protect the interests of each and all concerned and provide for a normal development of the industry.

PREPARATION OF THE LAND

The system of cultivation in use on the henequen plantations is determined largely by the unusual soil conditions previously described. In the henequen-producing districts most of the land is so rocky that plowing is out of the question. The preliminary work of preparing a field for planting is to clear the land of all trees and undergrowth. This work is usually done early in the dry season, in order that all waste material can be dried and burned before the rains begin. After the work of clearing is completed and if the field is one that has not previously been planted to henequen, it is surveyed and divided into small sections, known as mecates. A large henequen plantation is ordinarily divided into fields, each of which has an area of approximately 1,000 mecates (100 acres). Before any planting is done the fields are very carefully "lined out," and markers are placed where the henequen plants are to be set.

In earlier years when labor was abundant and cheap the different fields on the henequen plantations were separated by massive and carefully constructed stone fences, and the plantations were surrounded by even larger stone walls. There are numerous indications that, in all the work of preparing the fields for planting as well as in that which followed after planting, little economy was practiced in the use of labor. The marked change that has occurred in the labor situation will undoubtedly result in a corresponding change in plantation methods, particularly with respect to the preparation of the fields for planting.

METHODS OF PROPAGATION

Henequen may be propagated either from the suckers which grow from the rootstocks or from the small bulbils, or "pole plants," produced on the flower stalk. The relative merit of each of these methods is a subject concerning which there has been much controversy and one that has not been fully investigated.

Throughout Yucatan a marked prejudice exists against the use of bulbils as a means of propagation, and the use of suckers is practically universal. The planters have several reasons for preferring suckers: (1) Although pole plants are now abundant, in earlier years when nearly all the plantations were under intensive cultivation, few poles were allowed to mature and the supply of pole plants was very limited. Every large plantation, however, had an abundant supply of good sucker plants. (2) The pole plants must be grown in a nursery for one to two years, and conditions in Yucatan are unfavorable for nursery work. (3) It is claimed by the planters that the plants grown from bulbils are neither so strong nor so long lived as the plants grown from suckers. Results of experimental work conducted in other countries indicate that pole plants may give as satisfactory results as suckers. In view of existing conditions in Yucatan, however, the use of pole plants there can not be recommended.

NURSERY PLANTING

The essential function of the nursery is to provide a place where pole plants can be prepared for field planting or where small suckers can be planted and grown under more favorable conditions than they find in the fields. The advocates of nursery planting claim that it will pay even on plantations having an abundant supply of sucker plants. On the other hand, planters who do not favor nurseries state that field-grown suckers give just as satisfactory results as the nursery-grown plants and that the maintenance of a nursery is a needless expense. In actual practice there is very little nursery planting in Yucatan at the present time, whereas nurseries were formerly in general use.

The soil and climatic conditions are such that the establishment and maintenance of a nursery entails a relatively large expenditure. There are few locations in the henequen area where there is sufficient good soil for nursery work. In preparing for nursery planting it therefore becomes necessary to move soil from one place to another. In the nursery work it has heretofore been customary to use a mixture of henequen waste together with one and frequently with two or three different kinds of soil. In addition to this soil work, frequent watering of the nursery beds is necessary in this dry climate. With the present labor conditions it is doubtful whether nursery planting is advisable on plantations having an abundant supply of good sucker plants.

FIELD PLANTING

Field planting is ordinarily done shortly before the beginning of the rainy season. The suckers that are to be used for new plantings are gathered from the fields already planted, an effort being made to obtain strong, healthy plants that are about 18 inches in height. Very little attention is given to the selection of propagating stock

from superior plants. Suckers may be planted at once or they may remain out of the ground for two or three months. Fairly prompt planting is advisable. Before planting, the suckers are carefully sorted according to size, in order that each section of land planted may have as uniform a development of plants as possible.

Although there is some variation on the different plantations in the distance between rows and between the plants in the row, the general system of planting is very uniform. The planting distance which appears to give the best results is 4 varas (11 feet) between rows and $1\frac{1}{2}$ varas (50 inches) between the plants in the row. This system of planting gives 96 plants to the mecate, or approximately 960 plants to the acre. The number of plants is seldom less than 96 to the mecate, and frequently it is 108, 112, or 126. The double-row system of planting, which is used on the sisal plantations in Netherlands India, has been tried in Yucatan, but was considered unsatisfactory.

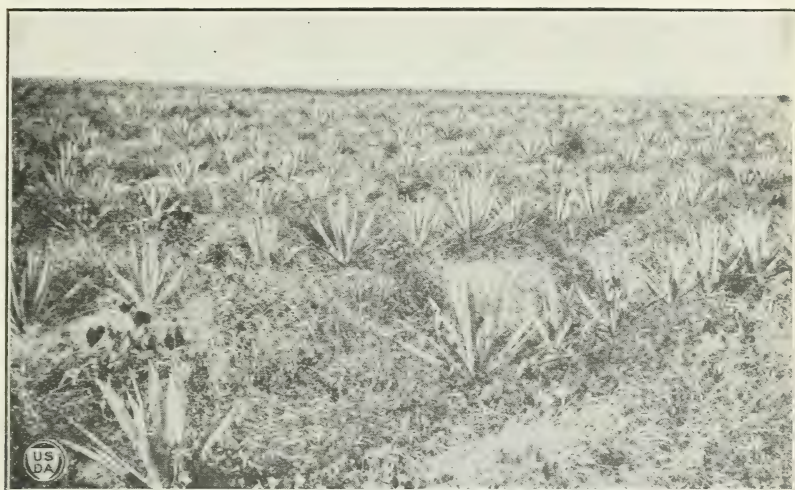


FIG. 3.—A field of young henequen plants

The method of planting is very simple, though it is important that the work be properly and carefully done. A small hole is prepared, in which the bulb is set and partly covered with earth. Where the land is very rocky and the quantity of soil is limited, the sucker plant is frequently propped up with small stones.

The plantations are usually laid out so that the rows run from east to west. This system of planting is used in order that the plants may get as much sunlight as possible and also on account of the prevailing winds.

After a field has been planted it is inspected at regular intervals and all plants that fail to grow or that die are replaced with new suckers (fig. 3).

Henequen does not exhaust the soil, but on a field that has produced the crop for a long period it is customary not to replant for three to five years.

SECONDARY CROPS

A field that has been prepared for henequen is frequently used for the production of a crop of corn before the henequen is planted. In some cases corn and beans are grown together. This preliminary crop, if successful, will pay for at least a part of the cost of clearing the land. After the henequen plants have been set, it is not customary for any secondary crop to be grown, though corn may be planted in the henequen fields during the early stages of growth.

CULTIVATION

The term "cultivation" in the sense in which it is ordinarily used is not an accurate description of the care that is given henequen. The only cultivation that this crop receives is an occasional cutting of the weeds and shrubs which grow between the rows. The frequency of these clearings varies with the quality of the soil, the season of the year, the age of the plants, the supply of labor, and the



FIG. 4.—A field of 7-year-old henequen plants

financial condition of the planter. It has been recommended that during the first year after the plants are set the fields be cleaned every three months, with a gradual lengthening of the interval as the plants become older. In actual practice, however, the fields of young plants are cleaned about once every six months and the older fields once every 12 months. There can be no general rule, as the conditions are variable in different districts (fig. 4).

The weeds and shrubs that are cut down when a field is cleaned are piled between the rows where they dry and gradually disintegrate. This large quantity of dry waste in the fields, particularly where clearing has been neglected for a long period, constitutes a serious fire menace in the dry season.

FERTILIZERS

No commercial fertilizers are used in connection with the production of henequen in Yucatan. The waste, or "bagasse," is occa-

sionally spread on the fields, but its fertilizing value is not sufficient to justify its transportation to the fields unless this can be done at a very low cost.

ENEMIES AND DISEASES

Henequen has two enemies which are found widely distributed throughout the fiber-producing areas of Yucatan and which in the aggregate do a great deal of damage. These enemies are the so-called max beetle, *Scypophorus acupunctatus*, and a small ratlike animal, the tuza.

The max is a large black beetle, the larva of which bores into the base of the cogollo, killing the plant. This beetle is sometimes destroyed with Paris green or with gasoline, but usually when discovered it has already done such serious damage that the plant must be destroyed. In districts where the max is prevalent the planters frequently offer a reward for the collection of these beetles. Plants that have been attacked by the max should be cut down and burned. The most satisfactory means of controlling this pest is to keep the fields in a condition of clean cultivation and free from old stumps or other decaying material.

The tuza is not so serious a pest as the max, but in certain districts this animal does considerable damage. It is found chiefly in the less rocky lands, burrowing underground and destroying both young and old plants by eating the roots. Various methods are recommended for the destruction of the tuza, including the use of carbon bisulphid in the burrows or of corn or other food products that have been poisoned with arsenic or strychnin.

Occasional reports of other insect pests or of diseases which attack henequen are received, but the damage is not serious.

FIRE DAMAGE

The most serious losses suffered by the henequen planters are caused by fire. During the long dry season the quantities of weeds and brush left between the rows when the fields are cleaned become as dry as tinder; and a fire once started in this material sweeps through a plantation with amazing rapidity, destroying in a few minutes a crop that it has taken years to produce. In some instances the fires are of incendiary origin, but more frequently they are the result of carelessness. The small planters who have made little clearings to be used for the planting of corn burn these clearings with no consideration for the safety of the large adjoining fields of henequen.

During 1922 approximately 14,000 acres of henequen were destroyed by fire, and the losses during the dry season of 1923 were about 7,000 acres. One reason for this large fire damage during the past two years was that many fields which had been neglected and contained much undergrowth were cleaned during this period. As an organized effort is now being made to clean all the neglected fields of henequen, it is probable that the fire losses will be reduced during the coming years.

HARVESTING

The length of the period between the time of planting and the time when the first leaves can be harvested depends upon the variety, the soil conditions, and the care that is given the plantation. Under

ordinary average conditions in Yucatan the first cutting is made six or seven years after the plants are set (fig. 5).

There is also great variation in the length of time that plants will continue to produce leaves. One planter made the statement that "a plant may pole in 3 or 30 years after the first cutting of leaves, depending on the variety, the conditions, and the treatment." The usual cutting period is about 16 years, although cases are reported of plants that have been cut for 30 years (fig. 6).

Both opinions and practice vary with respect to the number of cuttings made each year. An old Indian custom in Yucatan was



FIG. 5.—Carrying bundles of henequen leaves from the field to the roadway.

to cut two or three leaves from the plant each month. At present there are localities where only one cutting is made each year. Different planters recommend cutting at intervals of 3, 4, 6, and 9 months. Two cuttings per annum appear to be the usual practice on most of the well-managed plantations. There is variation also in the number of leaves obtained from each plant, the annual yield ranging from 18 to 36 fiber-producing leaves, 25 being considered a fair average.

It is important that the leaves be harvested when they are mature, as they will soon begin to deteriorate in quality.

It is equally important that overcutting be avoided. Where too many leaves are cut at one time the vitality of the plant is weakened, and the leaves subsequently produced will be inferior in quality. The best time of the year for leaf cutting is in September and October or in February and March.

Special efforts are made by the growers to plant in each field sucker plants of uniform size and to maintain a uniform development of the plants, but without systematic selection there will always be considerable difference in the size of the plants in any one field (fig. 7). In about six or seven years after the plants are set many of them will have leaves that are ready for cutting, when other plants in the same field will not be ready. Before the first

cutting of leaves is made, an expert cutter is sent through the field to mark all plants from which leaves are to be taken.

The leaf is cut off close to the trunk, from the upper surface downward, with a short sharp knife. The terminal spine is removed at the time the leaf is cut, and subsequently the marginal prickles are trimmed off. One man working alone will cut and trim from 1,500 to 2,500 leaves in a day. Working with members of his family, who do the trimming, one workman will cut from 6,000 to 7,000 leaves daily. This work is usually done by contract, the price paid for cutting being about 60 centavos (30 cents) for each thousand leaves. Ordinarily the leaves are tied in bundles of 50 before they are transported from the fields to the mill. Bundles of 40 are used where the leaves are exceptionally large.



FIG. 6.—A field of old henequen plants

HENEQUEN FIBER

CLEANING THE FIBER

On all of the larger henequen plantations in Yucatan the leaves are transported from the fields to the mill by means of plantation railways (fig. 8). The leaves are usually cleaned the day after they are cut, though sometimes two or three days may elapse between cutting and cleaning. It is stated that the leaves do not begin to deteriorate for a period of about three days after cutting.

When the leaves arrive at the mill the bundles are placed on carriers, which deposit them on the feeding table at the rear of the cleaning machine. There are usually three men working at the feeding table, one of whom opens the bundles, one arranges the leaves on the table, and one feeds the leaves into the machine. No effort is made to sort the leaves according to size, though on some of the plantations the damaged leaves are thrown out at the feeding table.

The machines used for cleaning the fiber are different types of the "Prieto" and the "Pascal" with an occasional "Mola." The capacity of these different machines varies from 10,000 to 20,000

leaves per hour, the larger ones cleaning from 150,000 to 200,000 leaves in a day; but all of them operate on the same general principle.

The leaves are fed sidewise in a continuous row into the machine. Each leaf is held near the center as it is carried forward past a rapidly revolving scraping wheel which removes the pulp from half of the leaf. The grasping device then shifts to the cleaned fiber, and a scraping wheel on the opposite side of the machine cleans the other half of the leaf. At each scraping wheel a small stream of water runs over the clean fiber. The machines are operated on an elevated platform, in order that the large quantity of waste may fall directly into dump cars that are run under the machine. As the cleaned wet fiber leaves the machine, it is assembled in small bundles and slid down an inclined pole to a workman standing on the ground.

DISPOSITION OF WASTE

As approximately 96 per cent of the total weight of the leaves is waste material, the disposition of this waste constitutes one of

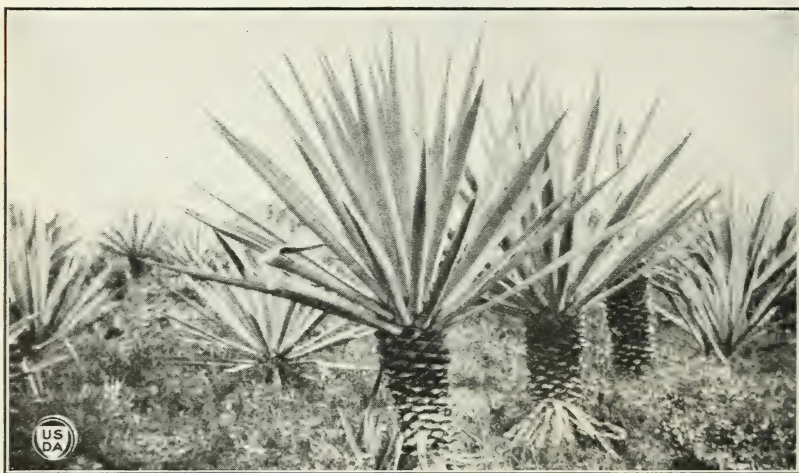


FIG. 7.—Henequen plants of the “chucún-ci variety at the Chuemichen plantation

the large items of expense in the operation of a henequen plantation. On all of the large estates a plantation railway runs from the mill to a dump in some near-by field. The waste falls from the machine into cars and is immediately carried to the dump. Small quantities of the waste when fresh and green are eaten by the cattle and hogs on the plantation.

Numerous attempts have been made to utilize henequen waste for the manufacture of either alcohol or paper, but this project has not yet been established on a commercial basis.

DRYING AND BALING FIBER

After leaving the machine the fiber is carried at once on small cars to the drying yards, where it is placed on racks and dried in the sun (fig. 9). Under favorable conditions the fiber will dry in five or six hours.

The drying rack on most of the plantations consists of heavy upright posts on which horizontal crosspieces are set about 3 feet

above the surface of the ground. Three or four double rows of galvanized wire are attached to these crosspieces, and the fiber is hung over these wires. In some instances a second crosspiece is set about 6 feet above the ground, and two layers of fiber are dried on the same rack. There is another system of drying in which a table-like platform about 3 feet above the ground is constructed with galvanized-iron tubing, and the fiber is laid out flat on this surface. This method is said to give excellent results, as the fiber becomes less tangled than when hung over the wires. The equipment used in this system is much more expensive, however, than the ordinary drying rack. While the fiber is drying and when it is taken from the drying racks an attempt is made to sort out and remove any damaged fiber.

The fiber is taken from the drying yard to the warehouse and is promptly baled. Different types of baling presses, most of which



FIG. 8.—A trainload of henequen leaves

have a capacity ranging from 20 to 40 bales a day, are used. As the plantation warehouses are usually small, very little loose fiber is allowed to accumulate.

There has been a wide variation in the size and weight of the bales of henequen fiber exported from Yucatan. An attempt is now being made to produce a uniform 400-pound bale but there is still considerable variation, and the weight of the bales ranges from 375 to 475 pounds.

CLASSIFICATION AND STANDARDIZATION OF FIBER

From the plantations the baled fiber is shipped by rail or boat to the central warehouses in Progreso, where it is inspected and prepared for shipment. Five different grades of fiber are recognized, these grades being determined by the color and the quality of cleaning. By means of a system of "castigos," an effort is now being made to encourage or to force the planters to produce a superior grade of fiber, uniform in quality. This movement toward improve-

ment in quality of fiber and uniformity in grading is worthy of commendation, but it appears that the method used to accomplish these ends is not entirely satisfactory. The term "castigos," meaning chastisement or punishment, is resented by the planters. In the grading of fiber the planter who supplies a low-grade product must necessarily suffer the consequences, and it would seem that it might be advisable to emphasize the idea of a reward for the production of a superior fiber rather than of punishment for an inferior production.

YIELD OF FIBER

A number of different factors affect the yield of henequen fiber, among the more important of which are (1) the variety of plant, (2) number of plants grown on a given area, (3) the number of leaves obtained from each plant in a year, and (4) the size and quality of the leaves.



FIG. 9.—Drying henequen fiber on racks

Complete and accurate data regarding the yields of the different varieties are not available. Also, very little information is obtainable concerning the relative yields where varying numbers of plants of the same variety are grown under the same conditions on the same area of land. In general, too thick planting results in reduced yields and fiber of inferior quality.

On one plantation where an average yield of 25 kilos (55 pounds) of fiber per 1,000 leaves was obtained, 1,000 leaves weighed 600 kilos (over 1,300 pounds), showing an average fiber content of a little over 4 per cent of the weight of the green leaves. On another plantation, where an average yield of 32 to 34 kilos (70 to 75 pounds) of fiber per 1,000 leaves was obtained, this number of leaves weighed 700 kilos (over 1,500 pounds), showing an average fiber content of nearly 5 per cent of the weight of the green leaves.

The average annual yield of fiber-producing leaves is about 25 for each of the 960 plants grown on 1 acre of land, and 1,000 leaves should average at least 50 pounds of fiber. These figures indicate an

average yield of 1,200 pounds of fiber per acre on the producing areas of Yucatan, but under existing conditions it is probable that the average yield is less.

LOCAL USES OF HENEQUEN FIBER

Two mills in Merida manufacture cordage chiefly in the form of binder twine, which is put up in 5-pound balls, packed in coarsely woven sacks made of henequen fiber, and exported principally to Argentina and to the United States. Henequen sacks are also manufactured at Merida, but are not exported, being used extensively in Yucatan and Campeche. Small quantities of fiber are used in Yucatan for making hammocks, hats, pouches, and other articles.

COST OF PRODUCING HENEQUEN FIBER

With the fluctuating cost of labor and the wide variation in conditions on different plantations, it is difficult to obtain data that will satisfactorily show the average cost of producing henequen in Yucatan at the present time.

One itemized statement prepared by a planter shows a producing cost of 2.6 cents United States currency per pound. An estimate furnished by another planter shows a producing cost of 3 cents per pound. It has been stated that the producer who receives $3\frac{1}{2}$ cents per pound for the fiber at the plantation can clean the fields already planted, harvest leaves, and prepare the fiber under existing conditions at a small profit. This profit, it is claimed by the planters, is not sufficient to provide funds for the planting of new areas or to encourage new planting.

PRESENT PRODUCTION

The production of henequen fiber in Yucatan and Campeche during recent years, according to data furnished by the Comisión Exportadora, has been as follows:

Production from 1912 to 1923

	Bales		Bales
1912-----	814, 610	1918-----	768, 723
1913-----	836, 950	1919-----	664, 972
1914-----	964, 862	1920-----	953, 034
1915-----	949, 639	1921-----	626, 980
1916-----	1, 191, 433	1922-----	434, 036
1917-----	733, 832	1923-----	612, 745

CONDITION OF PLANTATIONS

The condition of the plantations in Yucatan in July, 1923, although by no means all that could be desired, appeared to be improving. Work of cleaning the abandoned and semiabandoned fields had been organized, funds had been obtained for financing this work, and considerable progress was being made. Large areas still remained to be cleaned, however, and there were many fields so badly overgrown that they would have to be either replanted or abandoned altogether. The Comisión Exportadora stated that it was not possible to furnish data showing the areas in satisfactory condition, in poor condition, and considered as abandoned.

The situation with respect to the planting of new fields was less satisfactory than the degree of progress that had been made in cleaning the fields. There were relatively large areas of henequen from 2 to 5 years of age, but comparatively little planting had been done during the preceding 18 months.

MARKET SITUATION

During the latter part of 1921 Yucatan henequen was selling at a price of $2\frac{3}{4}$ cents Gulf, that is delivered at New Orleans or Mobile. The market was in a badly disorganized condition, there were large stocks of unsold fiber in the United States, the plantations in Yucatan were steadily deteriorating, and there existed a marked degree of uncertainty as to the future of the industry. Early in 1922 the Comisión Exportadora de Yucatan, the selling agency of which in the United States is the Sisal Sales Corporation, assumed the direction and control of the marketing of practically the entire output of Yucatan and Campeche.

The efforts of these two organizations have served to stabilize the market and check the decline in production, at least for the time being. There has been collected, compiled, and coordinated a large mass of data regarding the henequen industry in Yucatan. These records show in great detail the organization, equipment, systems of management, and the results that are now being obtained on the plantations. The quality of fiber has been somewhat improved by maintaining in the warehouses at Progreso a system of grading and standardization. A considerable part of the stocks of old fiber has been sold, and a stable price in the world markets has been maintained.

The selling price of $6\frac{1}{2}$ cents per pound for henequen, maintained with a variation of less than $\frac{1}{4}$ cent in this country throughout the years 1922 and 1923, is about $\frac{5}{8}$ cent above the average price during the years 1890 to 1914. The prices of other hard fibers, abaca, African and Java sisal, and Manila maguey, varied somewhat, with an average net increase of nearly 1 cent per pound during the two years. The price of henequen, in comparison with the prices of these other fibers, indicated a relative market value approximately the same as that shown by quotations in pre-war years, falling below somewhat toward the close of the period.

The planter in Yucatan has received $3\frac{1}{2}$ to $4\frac{1}{2}$ cents United States currency per pound for the fiber delivered at Progreso. An export duty ranging from 1 to $1\frac{1}{2}$ cents per pound is collected by the Government of Yucatan. The freight, exclusive of lighterage, from Progreso to New Orleans or Mobile is between 15 and 20 cents per 100 pounds, and 7 to 10 cents more to Philadelphia, New York, or Boston.

FUTURE PRODUCTION OF FIBER

It has been estimated by the Comisión Exportadora that the production of henequen fiber in Yucatan and Campeche will be approximately 600,000 bales for 1923, 700,000 bales for 1924, and 800,000 bales for 1925, with a continued production of about 800,000 bales per annum for a number of years. Other estimates indicate that production may either fall below or exceed these figures.

There are a number of different factors in the henequen industry concerning which there is an element of uncertainty, any one of which may materially affect the future production of this fiber. Many of the larger planters are heavily in debt and are without necessary capital for the efficient operation of their plantations. There is a shortage of labor, a marked degree of restlessness among the plantation laborers, and constant fluctuation in the wage scale. Any marked increase or decrease in the world consumption of henequen or in the production of the different fibers which compete with henequen will materially affect the situation in Yucatan.

HENEQUEN IN CAMPECHE

The State of Campeche adjoins Yucatan, and the production of henequen in these two regions may be regarded as essentially one

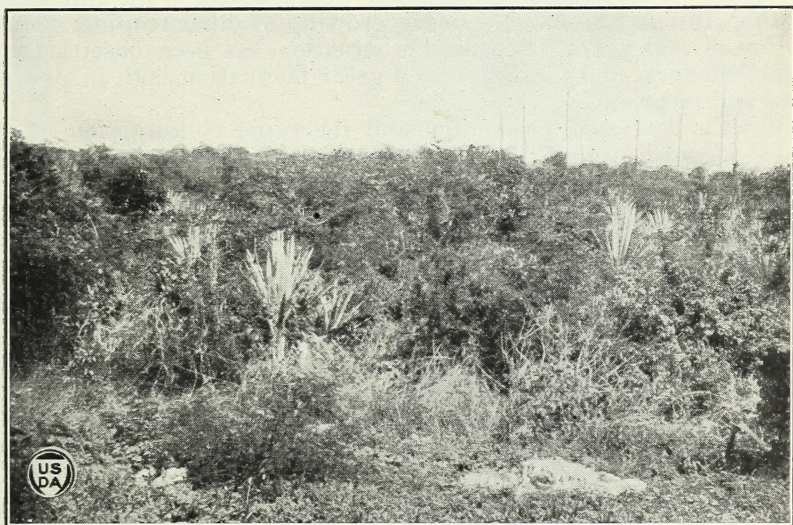


FIG. 10.—A neglected henequen plantation in Campeche

industry. Although there are certain differences in the soil conditions and in the system of cultivation, the situation in these two countries is practically the same.

The henequen industry of Campeche has suffered even more severely than that of Yucatan during the past few years. The production of henequen fiber in Campeche, which was formerly about 50,000 bales per annum, is now only 20,000 to 25,000 bales, and the rehabilitation of the plantations in that State is proceeding rather more slowly than in Yucatan (fig. 10).

The soil is less rocky and more fertile than that in the henequen areas of Yucatan. In consequence, the Campeche plants grow more vigorously, but the weeds and brush also flourish. It is claimed by the Campeche planters that this fiber is in every respect as good as, if not superior to, the Yucatan fiber.

The labor situation is very unsatisfactory. There is a great shortage of plantation labor, and wages are high. Many of the laborers who formerly lived in the country on the plantations are

now moving into the towns. Increasing areas are being planted to food crops, and the laborers who have an abundant supply of food are not disposed to work on the henequen plantations.

An organized effort is being made to rehabilitate the industry. Funds have been loaned to the planters for cleaning and replanting their fields, and fairly satisfactory progress has been made in this work.

SUMMARY

As Yucatan furnishes the greater part of the raw material used in the United States for the manufacture of binder twine, the condition of its henequen industry is a matter which concerns the American farmer.

The production of henequen is the one important industry of Yucatan. Both soil and climate are well adapted to the cultivation of this crop and ill adapted to the growing of other tropical staples.

For several years the henequen situation has been unsettled and unsatisfactory, and there has been great fluctuation both in production and in prices.

With a decreased production and the rapid consumption of the old stocks of henequen, there has existed the possibility of a shortage in the available supply of binder-twine fiber.

With changing economic and industrial conditions in Yucatan, corresponding changes in the methods of producing henequen are gradually being made.

The adjustment of the old to the new conditions is difficult, and there is need for cooperation on the part of officials, planters, and laborers.

The encouragement of investigational and experimental work with henequen would benefit the industry.

An organized effort is now being made to rehabilitate the henequen plantations, and considerable progress in this work has already been made.

During the 18 months preceding this field study, in July, 1923, a stable price for henequen fiber had been maintained, there had been an improvement in the quality, and a considerable part of the stocks of old fiber had been sold.

Uncertain factors in the henequen industry are the shortage of capital, the labor situation, and the possible increased production of competing fibers in other countries.

With stable economic, industrial, and political conditions in Yucatan and with no material change in the present prices of the fiber, the supply of henequen fiber, supplemented by other hard fibers, should be adequate during the next few years to meet the world demand.

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